N61165.AR.004254
CNC CHARLESTON
5090.3a

PHASE II INTERIM MEASURE WORK PLAN SOIL REMOVAL AT BUILDING 68 AREA OF CONCERN 620 (AOC 620) SOLID WASTE MANAGEMENT UNIT 36 (SWMU 36) ZONE F WITH TRANSMITTAL CNC CHARLESTON SC
12/27/2001
CH2M HILL

PHASE II INTERIM MEASURE WORK PLAN

Soil Removal at Building 68
AOC 620/SWMU 36, Zone F

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

PREPARED BY
CH2M-Jones

December 2001

Revision 0
Contract N62467-99-C-0960
158814.ZF.PR.07

PHASE II INTERIM MEASURE WORK PLAN

Soil Removal at Building 68
AOC 620/SWMU 36, Zone F

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

PREPARED BY
CH2M-Jones

December 2001

Revision 0
Contract N62467-99-C-0960
158814.ZF.PR.07

CH2M HILL
3011 S.W. Williston Road
Gainesville, FL
32608-3928
Mailing address:
P.O. Box 147009
Gainesville, FL
32614-7009
Tel 352.335.7991
Fax 352.335.2959

CH2MHILL

December 27, 2001

Mr. David Scaturo
Division of Hazardous and Infectious Wastes
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: Phase II IM Work Plan (Revision 0) – SWMU 36/AOC 620, Zone F

Dear Mr. Scaturo:

Enclosed please find four copies of the Phase II IM Work Plan (Revision 0) for SWMU 36/AOC 620 in Zone F of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Louise Palmer. Please contact her at 704/329-0073, extension 296, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Rob Harrell/Navy, w/att
Gary Foster/CH2M HILL, w/att

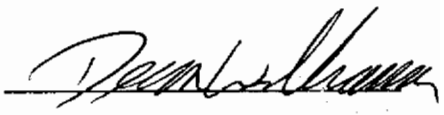
Certification Page for Phase II Interim Measure Work Plan (Revision 0) — AOC 620/SWMU 36, Zone F

Soil Removal at Building 68

I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428



Dean Williamson, P.E.

12/20/2001

Date

Contents

Section			Page
Acronyms and Abbreviations			**v**
1.0	**Introduction**		**1-1**
	1.1	Purpose of the Phase II Interim Measure Work Plan	1-1
	1.2	AOC 620/SWMU 36 Background	1-2
	1.3	Organization of the Phase II IM Work Plan	1-2
2.0	**Results of the Phase I Interim Measure**		**2-1**
	2.1	Phase I Interim Measure Pre-excavation Soil Sampling	2-1
		2.1.1 Soil Lead in the Wash Basin Area	2-2
		2.1.2 Soil Mercury in the Wash Basin Area	2-3
		2.1.3 Soil Lead in Acid Tank Room Area	2-3
		2.1.4 SPLP Results-Lead	2-4
		2.1.5 SPLP Results - Mercury	2-4
		2.1.6 TCLP Lead and pH Results	2-4
	2.2	Phase I IM Pre-excavation Groundwater Sampling	2-5
Table 2-1 Phase I IM Work Plan Soil Sampling Results			2-6
Figure 2-1 IM Pre-excavation Samples in Wash Basin Area			2-10
Figure 2-2 IM Pre-excavation Samples in Acid Tank Area			2-11
Figure 2-3 Lead in Soil in Wash Basin Area			2-12
Figure 2-4 Mercury in Soil			2-13
Figure 2-5 Lead in Soil in Acid Tank Area			2-14
Figure 2-6 Lead in Groundwater			2-15
3.0	**Identification of Media Cleanup Standards at AOC 620**		**3-1**
	3.1	Background Concentrations for the COCs	3-1
	3.2	Health-Based MCS	3-1
		3.2.1 Health-Based MCS for Lead	3-2
		3.2.2 Health-Based MCS for Mercury	3-2
	3.3	Site-Specific SSLs	3-2
		3.3.1 Site-Specific DAF	3-3
		3.3.2 Partitioning Coefficient for Lead	3-4
		3.3.3 Partitioning Coefficient for Mercury	3-5
		3.3.4 SSL for Lead at AOC 620	3-6

3.3.5 SSL for Mercury at AOC 620 3-6
3.4 Application of MCS for Lead at AOC 620 3-6
3.5 Application of MCS for Mercury at AOC 620 3-7
Table 3-1 Background Concentration Range (Zones F and G) 3-8
Table 3-2 Partitioning Coefficients and SSLs 3-9
Table 3-3 Final Lead Cleanup Concentrations 3-12
Table 3-4 Mercury in Surface and Subsurface Soil 3-13
Figure 3-1 Lead Kd in IM Pre-excavation Samples 3-15
4.0 Technical Approach to IM Soil Removal 4-1
4.1 Contaminant Delineation 4-1
4.1.1 Wash Basin Area 4-1
4.1.2 Acid Tank Area 4-3
4.2 Soil Excavation in Area A 4-3
4.3 Waste Management and Disposal 4-4
Table 4-1 Summary of Lead in Surface Soil 4-5
Table 4-2 Summary of Lead in Subsurface Soil 4-7
Table 4-3 TCLP Results 4-9
Figure 4-1 Soil Excavation in Wash Basin Area 4-10
5.0 Phases II and III Interim Measure Completion Report 5-1
6.0 References 6-1

Appendices

A Calculations for partitioning coefficient and SSL values for lead and mercury
B Supporting Parameters for Calculating DAF

Acronyms and Abbreviations

ALM	Adult Lead Methodology
AOC	area of concern
BCT	BRAC Cleanup Team
BRC	background reference concentration
CNC	Charleston Naval Complex
COC	chemical of concern
DAF	dilution attenuation factor
EPA	U.S. Environmental Protection Agency
ft bls	feet below land surface
IM	interim measure
L/kg	liters per kilogram
MCL	maximum contaminant level
MCS	media cleanup standard
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
PPE	personal protective equipment
RBC	risk-based concentration
SB	subsurface (soil)
SPLP	synthetic precipitation leaching procedure
SS	surface (soil)
SSL	soil screening level
SWMU	solid waste management unit
TCLP	toxicity characteristic leachate procedure
TSDF	treatment, storage, and disposal facility

Section 1.0

1.0 Introduction

1.1 Purpose of the Phase II Interim Measure Work Plan

An Interim Measure (IM) is proposed to remove soils contaminated with lead at Area of Concern (AOC) 620 and Solid Waste Management Unit (SWMU) 36 in Zone F of the Charleston Naval Complex (CNC). The IM will be conducted in the following three phases:

- Phase I —Pre-excavation sampling
- Phase II —Soil removal
- Phase III — Additional soil removal following demolition of Building 68

The Phase I pre-excavation sampling at AOC 620 has been conducted in accordance with the *Phase I Interim Measure Work Plan; Pre-Excavation Sampling and Analysis Plan; AOC 620/SWMU 36, Zone F* (CH2M-Jones, September 2001). The Phase II IM involves excavating and removing soils as needed within the accessible areas of AOC 620, before demolition of Building 68. Phase III of the IM will involve excavation under Building 68 in an area that is not readily accessible, and will occur after building demolition (by other contractors). The Phase III soil removal area will be determined after collecting additional pre-excavation samples, and will be presented in the Phase III IM Work Plan.

This Work Plan for the Phase II IM presents the following:

- The results of the Phase I pre-excavation sampling
- The media cleanup standards (MCSs) for AOC 620
- Target soil excavation areas
- Excavation and stockpiling details
- Waste disposal practices to be used for the soils
- The proposed content of the IM Completion Report

This IM will address the removal of surface and near-surface (above the water table) soils that exceed the appropriate surface and subsurface soil MCSs for lead. Because mercury was also detected at levels higher than the generic soil screening level (SSL) in some samples where lead contamination was identified, this Work Plan will also address whether remediation of mercury-containing soils is necessary as part of the IM.

1.2 AOC 620/SWMU 36 Background

AOC 620/SWMU 36 is located in the industrial area of Zone F, east of Hobson Avenue. The area is zoned for heavy industrial use. AOC 620 is the site of Building 68, the former Battery Shop. SWMU 36 is located within the Acid Tank room in the south central portion of the building and is the site of sulfuric acid releases. Because SWMU 36 is a small part of AOC 620, the site will be referred to only as AOC 620.

On two occasions, the floor drain to the waste acid holding tank south of Building 68 separated from the floor allowing approximately 1,025 gallons of sulfuric acid to discharge to the soil below the Acid Tank Room. Following each spill, a sodium carbonate solution was used to neutralize the soil below the building.

Two areas at AOC 620 where lead has been identified at elevated concentrations in soil are:

- Near two wash basins along the eastern wall in the northeast portion of the building, and the drain line from these basins that extended parallel to the building beneath the eastern loading dock, designated the Wash Basin Area.
- Beneath the acid tank room area, including the exterior area south of the building, which is designated the Acid Tank Area.

Additional details of the regulatory background and description of AOC 620 are described in the *Phase I Interim Measure Work Plan* (CH2M-Jones, September 2001) and *Zone F RFI Report, Revision 0* (EnSafe Inc. [EnSafe], 1997).

1.3 Organization of the Phase II IM Work Plan

This Phase II IM Work Plan consists of the following sections, including this introductory section.

1.0 Introduction — Presents the purpose of the Work Plan and background information regarding the site.

2.0 Results of Phase I Interim Measure – Presents the results of the Phase I IM Pre-excavation sampling.

3.0 Identification of Media Cleanup Standards – Identifies and presents the derivation of the MCSs for lead and mercury at AOC 620.

4.0 Technical Approach for the Interim Measure— Provides a brief description of the technical approach for the IM soil removal, including identification of the proposed excavation area and procedures for waste management.

5.0 Interim Measure Completion Report — Describes the proposed contents of the IM Completion Report.

6.0 References — Lists the references used in this document.

Appendix A presents calculations for partitioning coefficient and SSL values for lead and mercury.

Appendix B presents supporting parameters for calculating Dilution Attenuation Factor (DAF).

All tables and figures are presented at the end of their respective sections.

Section 2.0

2.0 Results of Phase I Interim Measure

This section presents the results of the Phase I IM pre-excavation sampling. Both soil and groundwater samples were collected during the Phase I IM at AOC 620. Details regarding the purpose of the Phase I samples are provided in the *Phase I IM Work Plan, AOC 620/SWMU 36, Zone F, Revision 0* (CH2M-Jones, 2001). Samples were analyzed for lead and mercury in soil and synthetic precipitation leaching procedure (SPLP) leachate, for pH and toxicity characteristic leachate procedure (TCLP) lead in soil, and for lead and mercury in groundwater. Soil sample results are compared to background values in this section, and will be compared to appropriate risk-based and SSL values in Section 4.0 of this IM Work Plan.

2.1 Phase I Interim Measure Pre-excavation Soil Sampling

The Phase I IM involved collecting surface and subsurface soil samples to further delineate the extent of soils exceeding the MCS. For the Phase I sampling effort, the extent of soils with lead concentrations higher than 1,000 milligrams per kilogram (mg/kg) (the industrial land use screening value) was delineated in the Wash Basin Area. Pre-excavation sampling in the Acid Tank Area was started and may be completed after building demolition, which will allow better access to the soil beneath the building and allow for more detailed lead delineation.

Figure 2-1 presents the locations of samples collected in the Wash Basin Area, and Figure 2-2 presents the locations of samples collected in the Acid Tank Area. Soil samples previously collected by EnSafe and CH2M-Jones for the AOC 620 RFI are also shown on the figures.

Thirty-two surface soil [0 to 1 ft below land surface (ft bls)] and 29 subsurface soil (2 to 3 ft bls) samples were collected for the Phase I IM at AOC 620. Subsurface soil samples were collected at 2 to 3 ft bls because historic water level measurements indicated that the groundwater table in the AOC 620 area is approximately 4 ft bls. Soil borings 620SB022 through 620SB035 and 620SB053 through 620SB057 were collected in the Wash Basin Area, and soil borings 620SB036 through 620SB046 and 620SB058 through 620SB060 were collected in the Acid Tank Area. Subsurface obstructions were encountered adjacent to the loading dock in the Wash Basin Area, therefore, subsurface soil samples were not collected at locations 620SB029, 620SB030, or 620SB031. Soil samples designated 620SB058 and 620SB059 were collected at previous sample locations 620SB036 through 620SB038 for waste disposal

evaluation. Soil samples from locations designated 620SB054 and 620SB057, each composited from two aliquots, were also collected for waste disposal evaluation.

All soil samples were analyzed for lead, except for 620SB058 and 620SB059, which were analyzed for pH and TCLP lead. Composite samples 620SB054 and 620SB057 were also analyzed for pH and TCLP lead. Fourteen samples were analyzed for SPLP lead, in order to establish a site-specific partitioning coefficient for lead. The SPLP samples were selected to be representative of both the Acid Tank Area and the Wash Basin Area, and of both surface and subsurface soil. These samples represent a range of total lead concentrations from 3 to 3,900 mg/kg. In addition, surface and subsurface soil samples at six locations in the Wash Basin Area were analyzed for mercury, with three SPLP mercury tests.

Table 2-1 lists the results of analyses on Phase I IM surface and subsurface soil. The following subsections discuss the analytical results.

2.1.1 Soil Lead in the Wash Basin Area

Wash Basin Area - Inside Building 68

Sample locations 620SB022 through 620SB028 were collected inside Building 68, beneath and surrounding the wash basins. Figure 2-3 shows lead concentrations for both surface soil and subsurface soil, labeled (SS) and (SB) on the figure. Lead concentrations in both surface and subsurface soil were generally within background levels for Zones F and G soils, with one subsurface soil measurement of 157 mg/kg at 620SB022, beneath the wash basin, and the rest of the measurements ranging from 3 to 25 mg/kg. The background range for surface soil in combined Zones F and G is 3.5 to 275 mg/kg, and the range for subsurface soil is 2.4 to 123 mg/kg.

Wash Basin Area - Outside Building 68 and Outside of the Loading Dock

Borings 620SB029, 620SB030, 620SB031, 620SB055, and 620SB056 were sampled for lead in soil beneath the pavement; obstructions prevented collection of subsurface soil samples at the first three locations listed. With the exception of sample location 620SB030, where lead was measured at 476 mg/kg, all samples located outside of the loading dock had lead concentrations within or below the range of background concentrations, as shown on Figure 2-3.

Wash Basin Area - Beneath the Loading Dock

Beneath the loading dock, borings 620SB032 through 620SB035, 620SB053, and composite samples 620SB054 and 620SB057 were sampled for lead in surface and subsurface soil. Lead

was detected at concentrations ranging from 98 mg/kg to 1800 mg/kg in the Phase I IM samples, as shown in Figure 2-3. Lead had previously been detected in soil beneath the loading dock as high as 18,400 mg/kg in surface soil, at 620SB018.

The southernmost IM sample location beneath the loading dock, 620SB035, had lead concentrations of 770 mg/kg in the surface soil and 303 mg/kg in subsurface soil, below the Phase I delineation value of 1,000 mg/kg. The northernmost IM sample location beneath the loading dock, 620SB053, had lead concentrations below the background range, and may be considered outside of the area impacted by a release from the battery operations and wash basin drain line. "Area A," shown on Figure 2-3, has been identified in the Wash Basin Area as the location with lead concentrations in surface and subsurface soil greater than 1,000 mg/kg.

2.1.2 Soil Mercury in the Wash Basin Area

Previous RFI samples collected in the loading dock area revealed mercury beneath the loading dock at concentrations ranging from 3.78 to 5.08 mg/kg in both surface and subsurface soils. These levels are higher than Zones F and G background concentrations (0.06 to 2.0 mg/kg in surface soil and 0.04 to 0.57 in subsurface soil). The soil concentrations also exceeded the generic SSL of 1.0 mg/kg for DAF=10.

Phase I IM samples were collected in the Wash Basin Area at locations 620SB022, 620SB023, 620SB039, 620SB030, 620SB034, and 620SB053, as shown on Figure 2-4. As shown in Table 2-1 and Figure 2-4, the concentrations of the Phase I IM surface soil samples ranged from 0.031 to 1.68 mg/kg, all within the background range of samples. The subsurface soil sample from 620SB053 had mercury at 1.52 mg/kg, greater than the background range.

2.1.3 Soil Lead in Acid Tank Room Area

Acid Tank Area - Beneath Building 68

Figure 2-5 shows lead concentrations in the Acid Tank Room area of AOC 620. For the Phase I IM, surface soil and subsurface soil were collected from locations 620SB036, 620SB037, and 620SB038 beneath the Acid Tank room. As seen in Figure 2-5 and Table 2-1, these soil samples had lead concentrations ranging from 497 to 3880 mg/kg, all exceeding the range of background concentrations. Additional delineation is planned beneath Building 68 in the Acid Tank Room Area.

The Phase I IM samples collected west of the Acid Tank Room contained lead concentrations ranging from 57.5 to 242 mg/kg, similar to background values.

Acid Tank Area - Outside of Building 68

Phase I IM samples 620SB042 through 620SB046 and 620SB060, including both surface and subsurface soil, were collected outside of Building 68 in the general vicinity of the acid UST and piping. Surface and subsurface soil samples were also collected from location 620SB041, adjacent to the previous RFI sample 620SB004. Lead concentrations in the samples collected outside of the building ranged from 2.81 mg/kg to 736 mg/kg.

2.1.4 SPLP Results - Lead

SPLP tests were conducted on selected samples representative of the Wash Basin and Acid Tank Areas, and representative of both surface soil and subsurface soil having a range of lead concentrations. Lead concentrations in the SPLP leachate are presented in Table 2-1. Leachate concentrations ranged from non-detect (< 17.2 micrograms per liter [µg/L]) to 2,740 µg/L.

2.1.5 SPLP Results - Mercury

SPLP tests were conducted on three soil samples from the Wash Basin Area to derive a site-specific SSL for the area. As presented on Table 2-1, samples from 620SB030 (surface soil) and 620SB034 (both surface and subsurface soil) were analyzed by the SPLP. Mercury was not detected (< 0.73 µg/L) in the leachate from the surface soil samples, but was detected in the leachate from the subsurface soil sample at an estimated concentration of 4.22 µg/L.

2.1.6 TCLP Lead and pH Results

Lead was tested in the leachate created by the TCLP on four samples from Area A and two samples from the Acid Tank Area. Some of the samples were composites, as shown on Figures 2-1 and 2-2.

Wash Basin Area

Surface soil was composited from two locations in the northern half of Area A to form surface sample 620SB054. Subsurface soil was composited from the same two locations to form the subsurface sample 620SB054. The surface sample contained lead at 31.2 milligrams per liter (mg/L) in the leachate; the subsurface sample had lead at 0.743 mg/L in the leachate. The samples had pH of 5.80 and 6.18 in the surface soil and the subsurface soil, respectively.

Two locations within the southern half of Area A were combined to form surface and subsurface samples 620SB057. The surface soil sample contained lead at 0.273 mg/L in the

leachate, and the subsurface soil sample contained lead at 0.084 J mg/L. The samples had pH of 6.95 and 6.57 in the surface soil and the subsurface soil, respectively.

Acid Tank Area

Subsurface soil was composited from sample locations 620SB036 and 620SB038 to form sample 620SB058. This sample contained lead in the leachate at 1.98 mg/L; the soil had a pH of 5.06. Surface soil from sample location 620SB037 was re-sampled to form 620SB059; no lead was detected in the TCLP leachate; the soil had a pH of 4.85.

2.2 Phase I IM Pre-excavation Groundwater Sampling

Phase I IM groundwater samples were collected at monitoring well F620GW002, located approximately 30 ft downgradient from the wash basins, and from F620GW004, located 7 ft outside of the Acid Tank room at the location where lead was detected in soil at 4250 mg/kg during the RFI sampling. These wells are shown on Figure 2-7. The sample from F620GW002 was analyzed for lead and mercury; neither of the analytes was detected. The sample from F620GW004 was analyzed for lead; it was detected at an estimated (J) concentration of 3.56 μg/L, compared to the Zone G background reference concentration (BRC) of 4.6 μg/L. The Zone G BRC is used for comparison because BRC data for Zone F shallow groundwater is based on only one well and lead was not detected in it. The Zone G boundary is located approximately 30 ft south of Building 68, and Zone G is also composed of land use similar to Zone F.

Fig 2-7 presents all RFI lead data from the monitoring wells surrounding AOC 620. As seen in the figure, lead has been detected only in the wells along the south side of the building. Except for the 4/30/97 sample from 620GW004, the detected concentrations have been less than the BRC of 4.6 μg/L and less than the assumed maximum contaminant level (MCL) of 15 μg/L. The lead concentration at 620GW004, located adjacent to the Acid Tank Room, was initially measured at 30.7 μg/L in 1997, but the subsequent four sampling events have all resulted in concentrations less than background values, as mentioned above.

TABLE 2-1
Phase I IM Soil Sampling Results
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Complex

Parameter	Boring	Soil Sample Type	Soil Concentration mg/kg		SPLP Leachate µg/L		TCLP Leachate µg/L	pH	Background Range mg/kg	Boring Location
Lead	F620SB022	Surface	25.4	=					3.5 - 275	Wash Basin Area,
		Subsurface	157	=					2.4 - 123	Inside Building
	F620SB023	Surface	5.91	=					3.5 - 275	
		Subsurface	13.3	=					2.4 - 123	
	F620SB024	Surface	4.03	=					3.5 - 275	
		Subsurface	3.1	=					2.4 - 123	
	F620SB025	Surface	5.82	=					3.5 - 275	
	F620SB026	Surface	4.92	=					3.5 - 275	
		Subsurface	5.56	=					2.4 - 123	
	F620SB027	Surface	5.17	=					3.5 - 275	
		Subsurface	7.9	=					2.4 - 123	
	F620SB028	Surface	4.67	=					3.5 - 275	
		Subsurface	6.21	=					2.4 - 123	
	F620SB029	Surface	71.6	=					3.5 - 275	Wash Basin Area,
	F620SB030	Surface	476	=					3.5 - 275	Outside Loading Dock
	F620SB031	Surface	273	=					3.5 - 275	
	F620SB055	Surface	3.05	=	24.8	J			3.5 - 275	
		Subsurface	63.1	=	28.4	J			2.4 - 123	
	F620SB056	Surface	2.67	=	17.2	U			3.5 - 275	
		Subsurface	2.66	=	17.2	U			2.4 - 123	

TABLE 2-1
Phase I IM Soil Sampling Results
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Complex

Parameter	Boring	Soil Sample Type	Soil Concentration mg/kg		SPLP Leachate µg/L		TCLP Leachate µg/L		pH	Background Range mg/kg	Boring Location
Lead	F620SB032	Surface	1,500	=	1730	=				3.5 - 275	Wash Basin Area,
	F620SB032	Subsurface	1,120	=						2.4 - 123	Beneath Loading Dock
	F620SB033	Surface	430	=						3.5 - 275	(Area A)
		Subsurface	416	=	1,590	=				2.4 - 123	
	F620SB034	Surface	106	=						3.5 - 275	
		Subsurface	1,100	=	2,740	=				2.4 - 123	
	F620SB054	Surface	1,820	=			31,200	=	5.80	3.5 - 275	
	(Composite)	Subsurface	961	=			743	=	6.18	2.4 - 123	
	F620SB057	Surface	790	=			273	=	6.95	3.5 - 275	
	(Composite)	Subsurface	317	=			84	J	6.57	2.4 - 123	
	F620SB035	Surface	770	=	40.4	J				3.5 - 275	Wash Basin Area,
		Subsurface	303	=						2.4 - 123	Beneath Loading Dock,
	F620SB053	Surface	153	=	33.4	J				3.5 - 275	Outside of Area A
		Subsurface	97.8	=	26.8	J				2.4 - 123	
	F620SB036	Surface	570	=						3.5 - 275	Acid Tank Area,
		Subsurface	3,880	=	17.2	U				2.4 - 123	Beneath Building
	F620SB037	Surface	2,350	=						3.5 - 275	
		Subsurface	497	=	17.2	U				2.4 - 123	
	F620SB038	Surface	952	=						3.5 - 275	
		Subsurface	3,270	=	138	J				2.4 - 123	
	F620SB039	Surface	145	=						3.5 - 275	
		Subsurface	242	=						2.4 - 123	

TABLE 2-1
Phase I IM Soil Sampling Results
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Complex

Parameter	Boring	Soil Sample Type	Soil Concentration mg/kg		SPLP Leachate µg/L		TCLP Leachate µg/L		pH	Background Range mg/kg	Boring Location
Lead	F620SB040	Surface	93.5	=						3.5 - 275	
		Subsurface	57.5	=						2.4 - 123	
	F620SB058 (Composite)	Subsurface					1,980	=	5.06		
	F620SB059	Surface					17.2	U	4.85		
	F620SB041	Surface	736	=						3.5 - 275	Acid Tank Area,
		Subsurface	94.8	=						2.4 - 123	Outside Building adjacent to
	F620SB042	Surface	2.81	=						3.5 - 275	Acid Tank Room
		Subsurface	295	=						2.4 - 123	
	F620SB043	Surface	632	=	61.1	J				3.5 - 275	
		Subsurface	736	=						2.4 - 123	
	F620SB044	Surface	224	=						3.5 - 275	
		Subsurface	376	=						2.4 - 123	
	F620SB045	Surface	239	=						3.5 - 275	
		Subsurface	159	=						2.4 - 123	
	F620SB046	Surface	195	=						3.5 - 275	
		Subsurface	137	=						2.4 - 123	
	F620SB060	Surface	406	=						3.5 - 275	
		Subsurface	40.7	=						2.4 - 123	

TABLE 2-1
Phase I IM Soil Sampling Results
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Complex

Parameter	Boring	Soil Sample Type	Soil Concentration mg/kg		SPLP Leachate µg/L		TCLP Leachate µg/L	pH	Background Range mg/kg	Boring Location
Mercury	F620SB022	Surface	0.0659	J					0.06 - 2.0	Wash Basin Area,
		Subsurface	0.101	=					0.04 - 0.57	Inside Building
	F620SB023	Surface	0.031	J					0.06 - 2.0	
	F620SB029	Surface	0.0342	J					0.06 - 2.0	Wash Basin Area,
	F620SB030	Surface	1.68	=	0.73	U			0.06 - 2.0	Outside Loading Dock
	F620SB034	Surface	0.361	=	0.73	U			0.06 - 2.0	Wash Basin Area,
		Subsurface	0.576	=	4.22	J			0.04 - 0.57	Beneath Loading Dock
	F620SB053	Surface	1.06	=					0.06 - 2.0	
		Subsurface	1.52	=					0.04 - 0.57	

Background range from the combined Zones F and G grid sample concentrations

= Sample concentration
J Estimated concentration
SPLP Synthetic Precipitation Leaching Procedure
TCLP Toxicity Characteristic Leaching Procedure
U Analyte not detected; value is the detection limit

TABLE 2-1
Phase I IM Soil Sampling Results
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Complex

Parameter	Boring	Soil Sample Type	Soil Concentration mg/kg		SPLP Leachate µg/L		TCLP Leachate µg/L	pH	Background Range mg/kg	Boring Location
Mercury	F620SB022	Surface	0.0659	J					0.06 - 2.0	Wash Basin Area,
		Subsurface	0.101	=					0.04 - 0.57	Inside Building
	F620SB023	Surface	0.031	J					0.06 - 2.0	
	F620SB029	Surface	0.0342	J					0.06 - 2.0	Wash Basin Area,
	F620SB030	Surface	1.68	=	0.73	U			0.06 - 2.0	Outside Loading Dock
	F620SB034	Surface	0.361	=	0.73	U			0.06 - 2.0	Wash Basin Area,
		Subsurface	0.576	=	4.22	J			0.04 - 0.57	Beneath Loading Dock
	F620SB053	Surface	1.06	=					0.06 - 2.0	
		Subsurface	1.52	=					0.04 - 0.57	

Background range from the combined Zones F and G grid sample concentrations

= Sample concentration
J Estimated concentration
SPLP Synthetic Precipitation Leaching Procedure
TCLP Toxicity Characteristic Leaching Procedure
U Analyte not detected; value is the detection limit

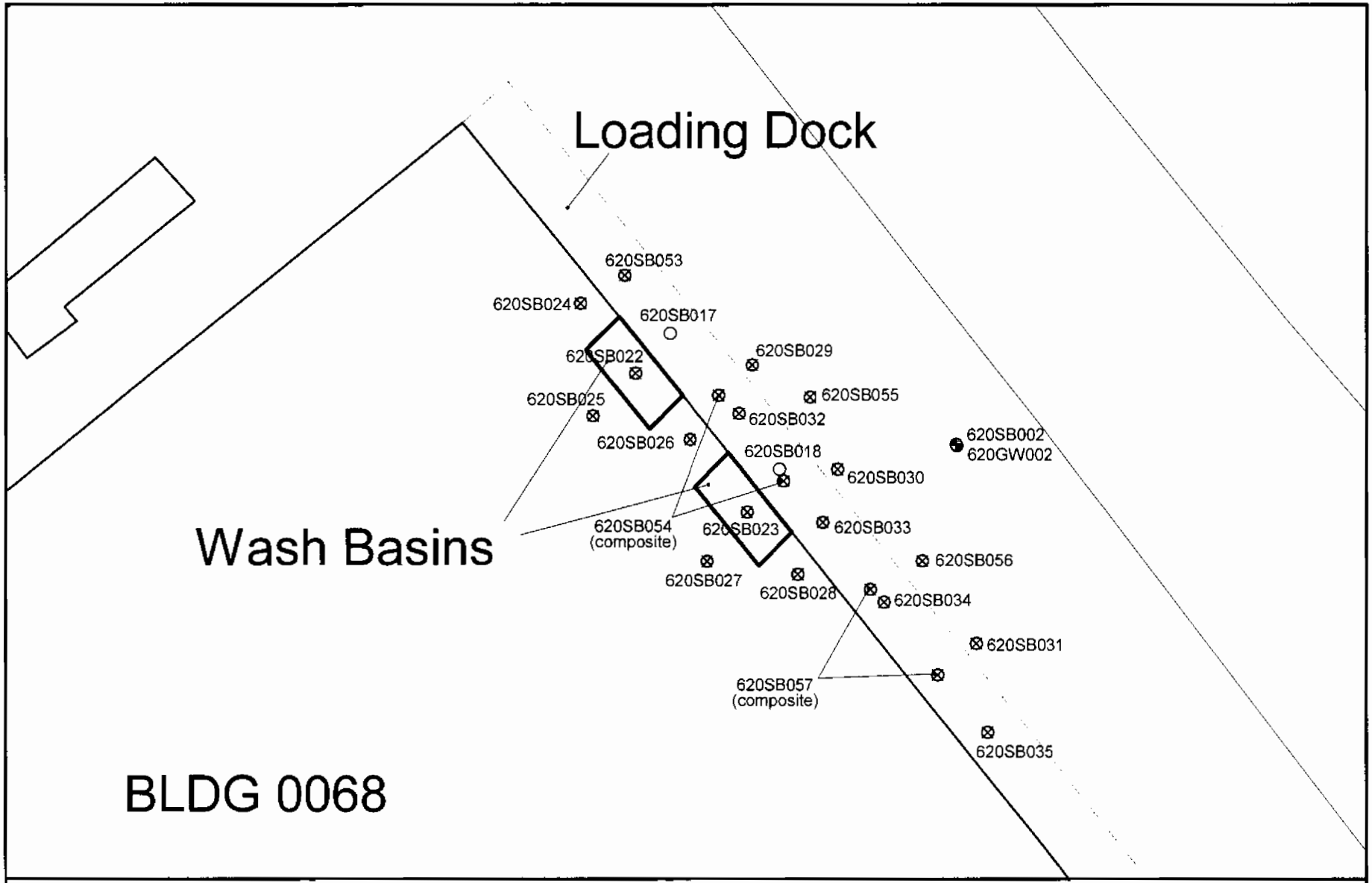


Figure 2-1
IM Pre-Excavation Samples in Wash Basin Area
AOC 620 IM Work Plan - Phase II
Zone F
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_F\Aoc_620\Aprs\aoc620_imworkplan_phaseii.apr, Date: 18 Dec 2001 13:34, User: ASPOSATO, EGIS: Charleston Naval Complex - Figure 2-1 IM Pre-Excavation Samples in Wash Basin Area

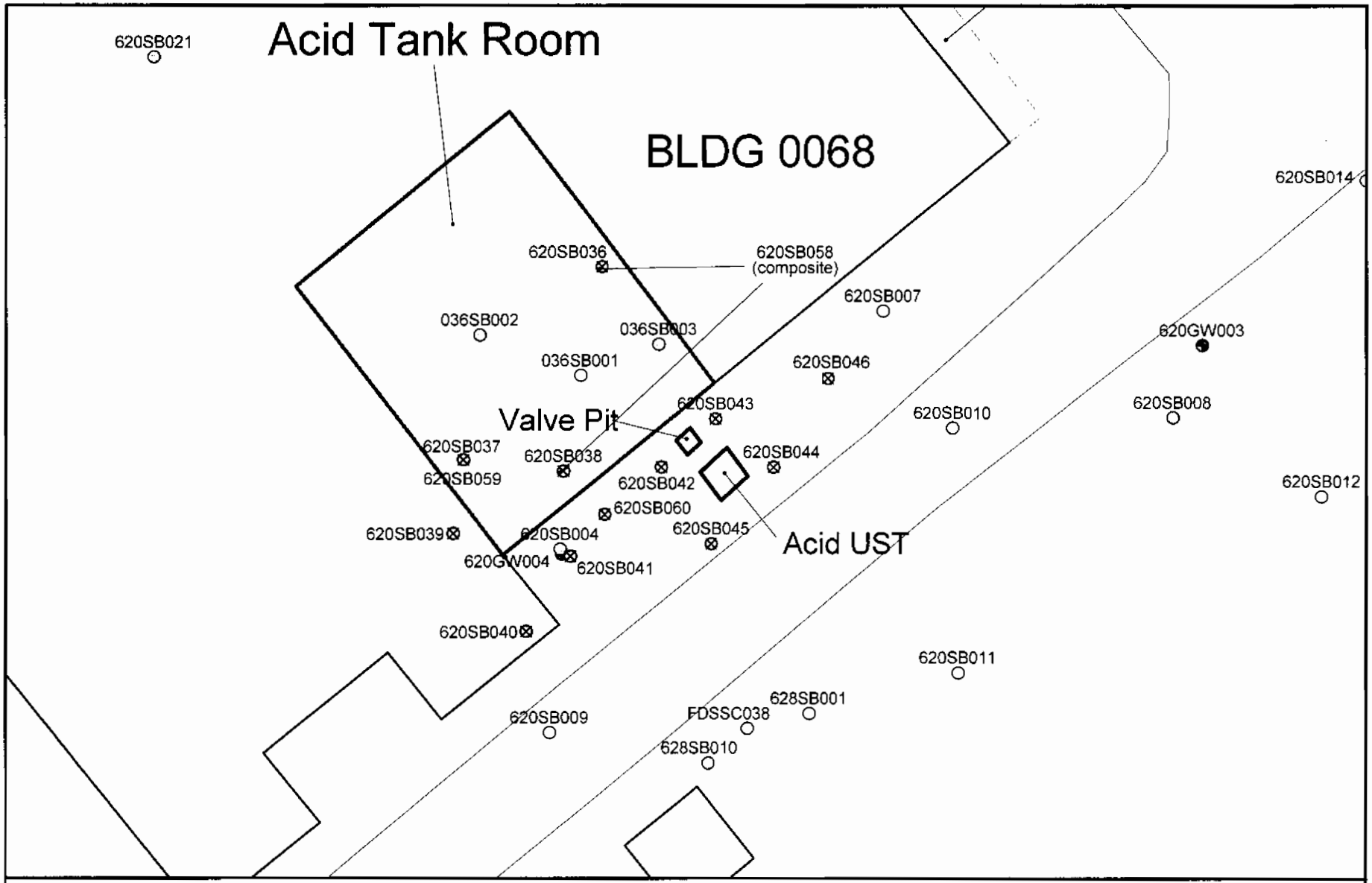


Figure 2-2
IM Pre-Excavation Samples in Acid Tank Area
AOC 620 IM Work Plan - Phase II
Zone F
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_F\Aoc_620\Aprs\aoc620_imworkplan_phaseii.apr, Date: 11 Dec 2001 11:45, User: ASPOSATO, EGIS: Charleston Naval Complex - Figure 2-2 IM Pre-Excavation Samples in Acid Tank Area

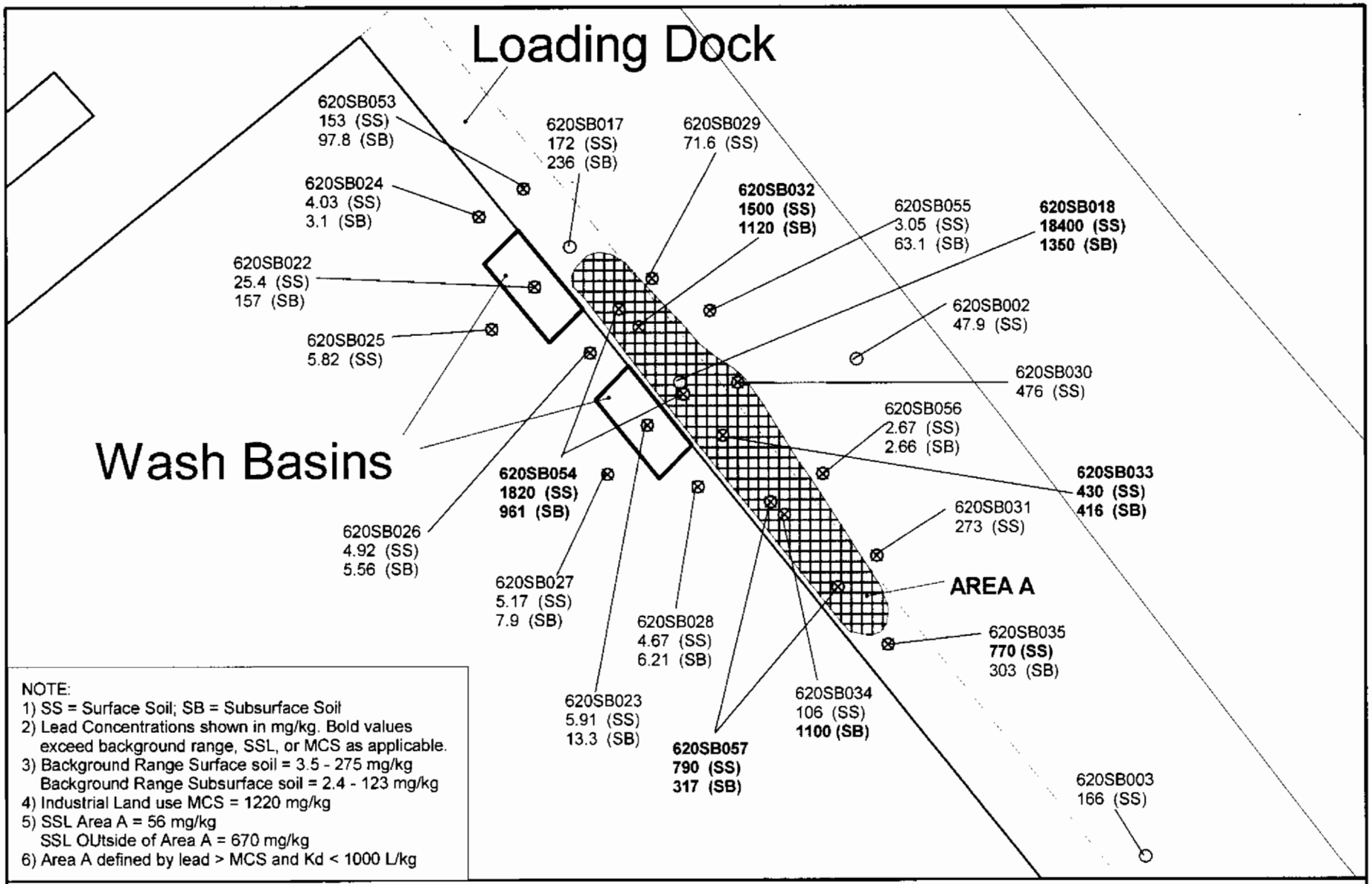


Figure 2-3
Lead in Soil in Wash Basin Area
AOC 620 IM Work Plan - Phase II
Zone F
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_F\Aoc_620\Aprs\aoc620_imworkplan_phaseii.apr, Date: 18 Dec 2001 13:44, User: ASPOSATO, EGIS: Charleston Naval Complex - Figure 2-3 Lead in Soil in Wash Basin Area

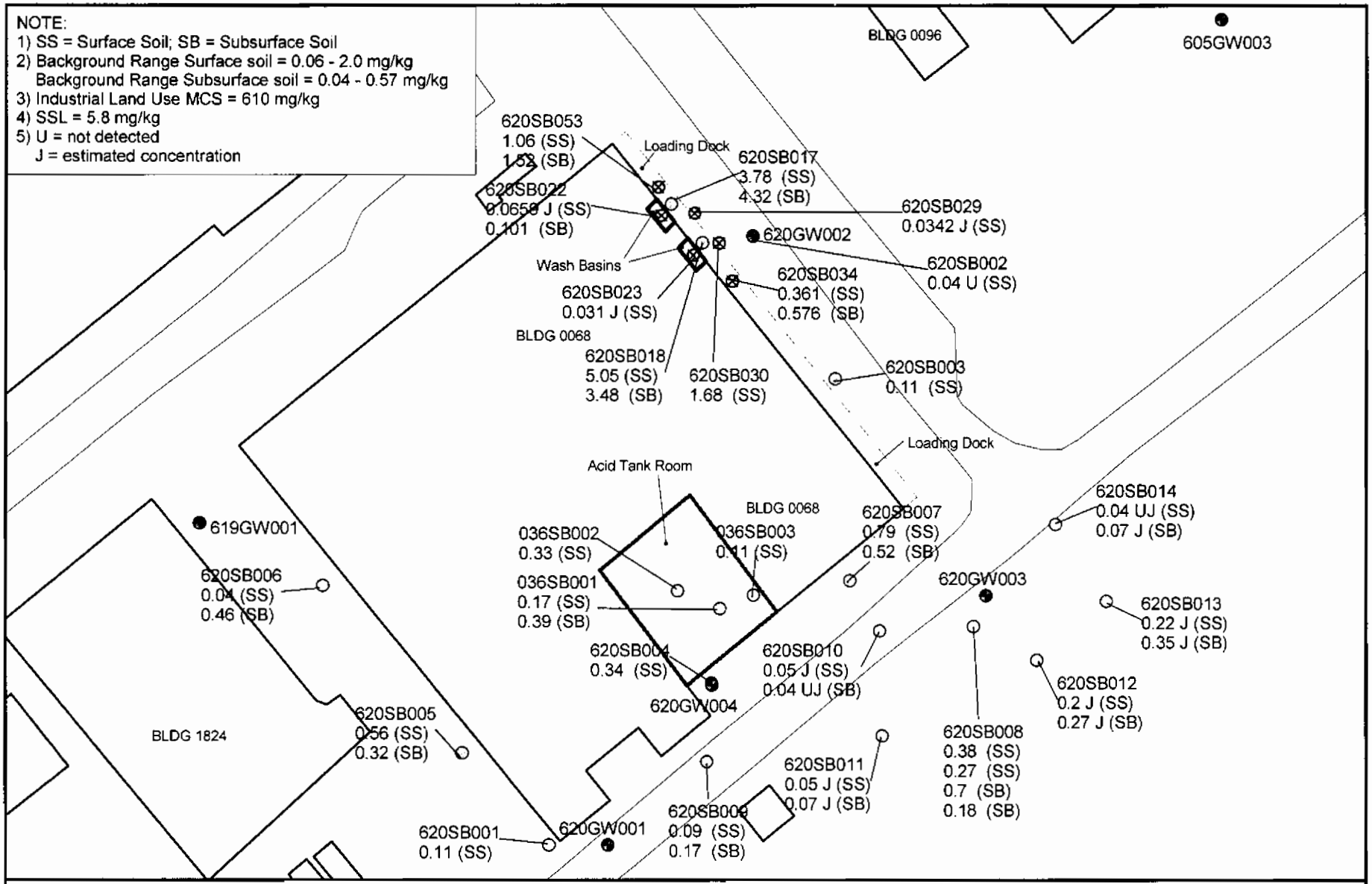


Figure 2-4
Mercury in Soil
AOC 620 IM Workplan - Phase II
Zone F
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_F\Aoc_620\Aprs\aoc620_imworkplan_phaseii.apr, Date: 18 Dec 2001 13:52, User: ASPOSATO, EGIS. Charleston Naval Complex - Figure 2-4 Mercury in Soil

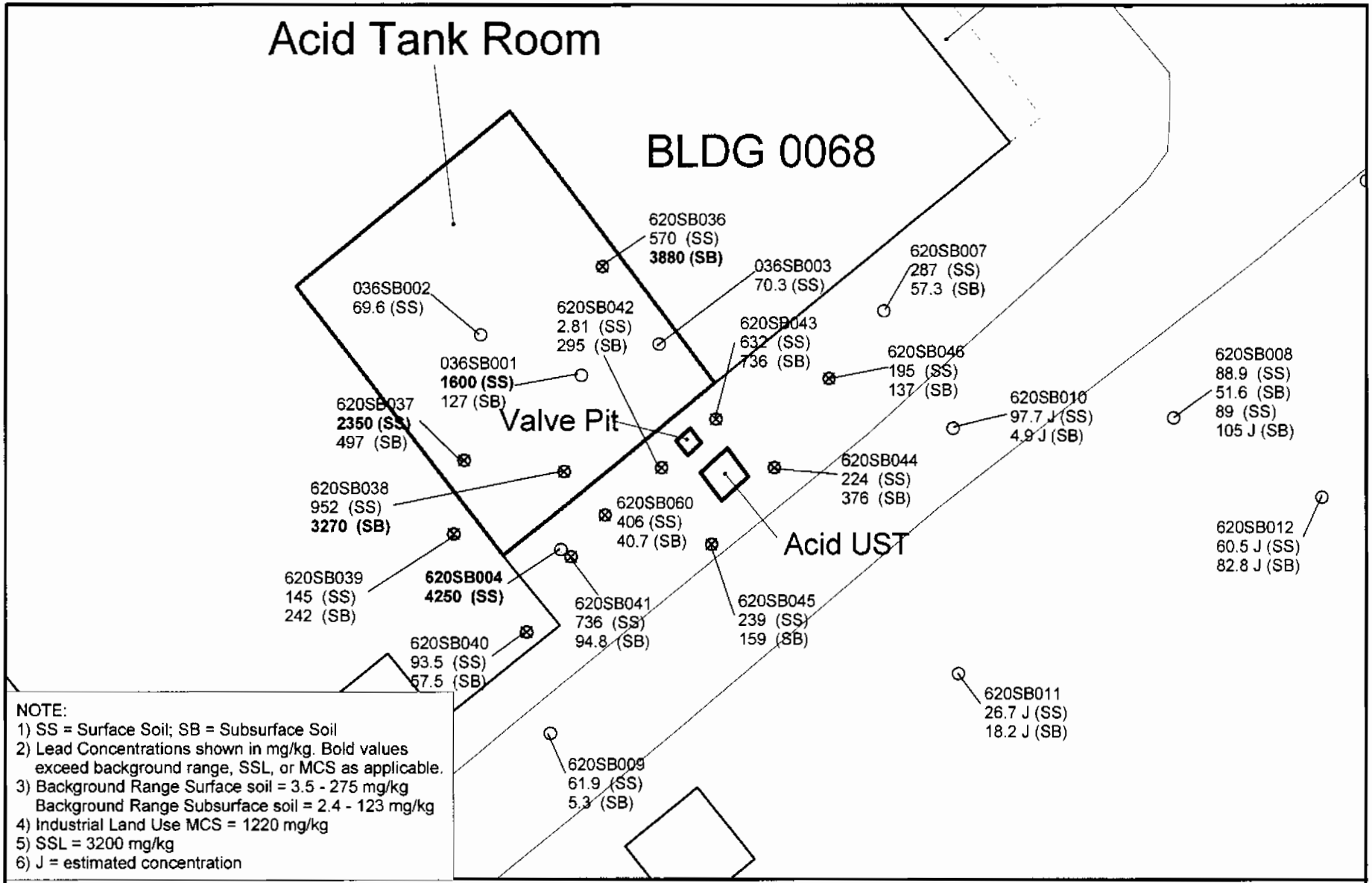


Figure 2-5
Lead in Soil in Acid Tank Area
AOC 620 IM Work Plan - Phase II
Zone F
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_F\Aoc_620\Aprs\aoc620_imworkplan_phaseii.apr, Date: 18 Dec 2001 13:57, User: ASPOSATO, EGIS: Charleston Naval Complex - Figure 2-5 Lead in Soil in Acid Tank Area

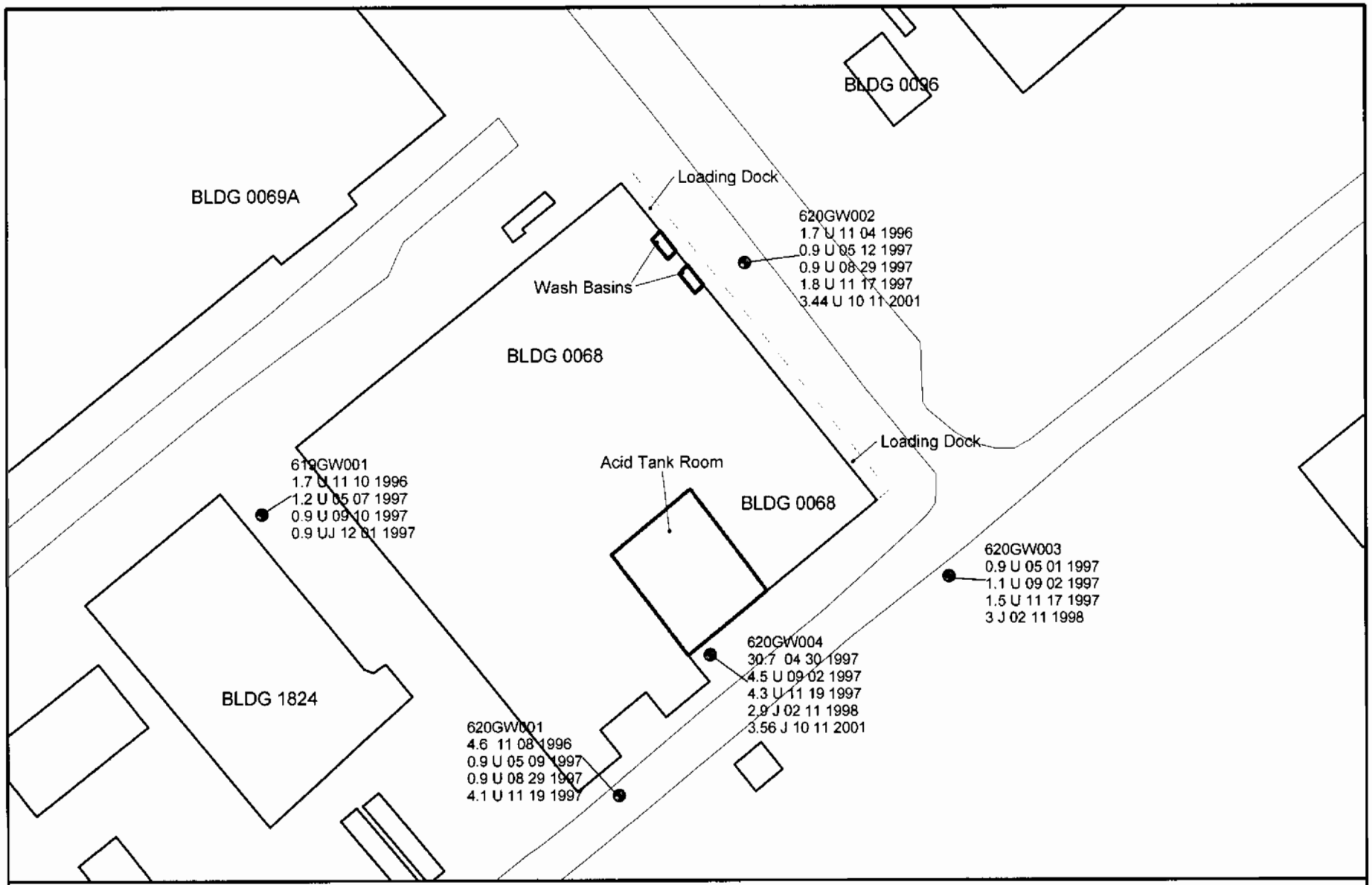


Figure 2-6
Lead in Groundwater
AOC 620 IM Work Plan - Phase II
Zone F
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_F\Aoc_620\Aprs\aoc620_imworkplan_phaseII.apr, Date: 18 Dec 2001 14:00, User: ASPOSATO, EGIS: Charleston Naval Complex - Figure 2-6 Lead in Groundwater

Section 3.0

3.0 Identification of Media Cleanup Standards at AOC 620

This section identifies the MCSs and describes how they are derived. The MCSs will be based on background levels, human health exposure-based concentrations, and soil concentrations protective of groundwater. The target MCS for surface soil (up to 1-ft depth) at AOC 620 will be no less than the upper bound of the background range and the minimum of the risk-based concentration (RBC) and the SSL. The target MCS for subsurface soil (between 1-ft depth and the water table, no greater than 4 ft) will be the greater of the SSL or the upper bound of the background range. Once a chemical of concern (COC) is established as exceeding background concentrations in a contaminated area, soils will be remediated to the lower of health-based MCSs and leachability-based MCSs (i.e., SSLs).

The exposure-based MCSs are described in the subsections below. For groundwater protection, SSLs are calculated using area-specific soil partitioning values and site-specific DAFs. The derivation of the site-specific DAF, the area-specific partitioning coefficients, and the area-specific SSLs are also described in the subsections below.

3.1 Background Concentrations for the COCs

Any concentrations detected within the range of background concentrations established for Zones F and G will be considered not related to site releases and will not be addressed further in this IM. The ranges of concentrations identified in Zones F and G grid-based background samples are listed in Table 3-1.

3.2 Health-Based MCS

To evaluate surface soil for the IM, concentrations will be compared to criteria derived on the basis of direct exposure to human receptors. The type of receptor is identified based on the current and future land use for the area. AOC 620 and the surrounding area are designated for industrial land use. Although a consideration will be given to achieve cleanup levels more stringent than restricted land use, the area will remain industrial and practical target goals will be selected to achieve industrial worker health protection. Thus, both an unrestricted land use-based MCS and an industrial use-based MCS are listed below

for each of the two COCs, lead, and mercury. However, ultimate objectives are selected on the basis of industrial land use.

3.2.1 Health-Based MCS for Lead

For unrestricted land use at the CNC, the BRAC Cleanup Team (BCT) has agreed to use the generally accepted target screening level, which may be used as a cleanup level of 400 mg/kg in surface soil, which is based on protection of residential children against lead exposure. A CNC-specific lead target value was developed to be protective of adults against lead exposure in areas identified for current and future industrial land use. The target lead MCS was derived from the U.S. Environmental Protection Agency (EPA) Adult Lead Methodology (ALM), as detailed in the *Technical Memorandum: Adult Lead Methodology (ALM) Derived Target Lead Concentrations for Industrial Land Use*, (CH2M-Jones, November 9, 2001).

The ALM is specifically used for calculating target lead concentrations protective of adult receptors, e.g., site workers. The ALM uses a biokinetic slope factor to represent lead biokinetecs, and an exposure model in which all exposure pathways, except the soil ingestion pathway, are represented by a background blood-lead concentration. As detailed in the *Technical Memorandum*, the ALM calculates a target cleanup value of 1,218 mg/kg, (rounded to three significant digits for 1,220 mg/kg) for industrial use sites. Average site residual concentrations will be compared with the target MCS value of 1,220 mg/kg. AOC 620 is zoned for heavy industrial usage, and land use restrictions are planned to be compatible with this usage.

3.2.2 Health-Based MCS for Mercury

The MCS for mercury is the RBC value from EPA Region III (October 2000) for mercuric chloride (inorganic mercury). The RBC value listed for unrestricted land use is 23 mg/kg, and for industrial land use is 610 mg/kg. Because AOC 620 is located in an area designated for current and future industrial use, an MCS value of 610 mg/kg is appropriate for protection of human health for workers in the area.

3.3 Site-Specific SSLs

Site-specific SSLs were derived using EPA SSL guidance (Soil Screening Guidance, EPA 1996). First, a DAF was calculated specific to AOC 620 and the surrounding area. Then, area-specific partition coefficients (K_d) values were calculated from the SPLP data collected at AOC 620. These two factors were used to calculate specific SSLs at AOC 620. While DAF

values vary depending on site properties, they are the same for all COCs at a site. K_d values depend on chemical properties and vary with the dynamics between the chemical and the soil in which it is present. The subsections below present the methods used to derive the SSLs.

3.3.1 Site-Specific DAF

DAFs have been calculated using the method presented in the EPA Soil Screening Guidance, 1996. Equations 11 and 12 from that document are used to derive DAF, as shown below.

Equation 11: $DAF = 1 + Kid/IL$

Where K = hydraulic conductivity = 4.0 ft/day = 445 m/yr

i = hydraulic gradient = 0.02 ft/ft

d = mixing zone thickness (from equation 12)

I = infiltration rate = 0.14 m/yr unpaved; 0.026 m/yr paved

L = source length parallel to groundwater flow direction = 80 ft = 25 m

The hydraulic conductivity is extrapolated from the USGS model presented in *Hydrogeology and Simulation of Ground-Water Flow in the Surficial Aquifer System in the Area of Charleston Naval Base, North Charleston, South Carolina, 1995-97, United States Geological Survey Administrative Report 1999*, and reproduced in Appendix A. The hydraulic gradient is estimated from the potentiometric surface map presented in the *Zone F RFI Report, Revision 0* (EnSafe, 1997) for AOC 620; a copy of it is presented in Appendix A. The mixing zone thickness is a function of the site properties, as described below. The derivation for the infiltration rates is presented in Appendix A; the unpaved condition will be used to evaluate a worst-case SSL. The source lengths for Area A and for the Acid Tank Area are both approximately 80 ft, using the longest dimension of each area containing elevated metals concentrations. These are conservative estimates for L, and are independent of the direction of groundwater flow; however, variations in this value have only minor effects on the resulting DAF calculation.

The mixing zone thickness, d, in meters, is calculated from Equation 12 from the Soil Screening Guidance:

Equation 12: $d = (0.0112L^2)^{0.5} + d_a\{1-\exp[(-LI)/(Kid_a)]\}$

Where L = source length parallel to groundwater flow direction = 25 m

d_a = aquifer thickness = 9.8 m

I = infiltration rate = 0.14 m/yr for unpaved

K = hydraulic conductivity = 445 m/yr

i = hydraulic gradient = 0.02

For the unpaved surface, the mixing zone thickness at AOC 620 is 3.0 m. Using this value, the DAF for the future unpaved condition in both the Wash Basin Area and the Acid Tank Area estimates as 8.7. For comparison, using an infiltration rate of 0.026 m/yr, representative of a paved condition, the DAF at AOC 620 calculates to 38.2. The more conservative value based on the unpaved scenario will be used to develop the leachability-based MCS for lead and mercury at AOC 620, because after demolition the site will be unpaved for at least a portion of the time.

3.3.2 Partitioning Coefficient for Lead

A partitioning coefficient (K_d) was calculated for each sample, on the basis of the quantities of soil and water used in the SPLP test and the resulting soil and leachate concentrations. The K_d is the ratio between the soil and the leachate concentrations, expressed in units of liters per kilogram (L/kg). Calculations are presented in Appendix B. The partitioning coefficient for each sample that was analyzed for lead by SPLP is listed in Table 3-2, and is shown in Figure 3-1.

As described in the *Technical Memorandum: Application of Soil-Screening Levels (SSLs) at Charleston Naval Complex* (CH2M-Jones, March 9, 2001), in the case where the metal is not detected in the leachate, one-half the detection limit is used for the leachate concentration to calculate K_d. This was done for the samples from 620SB036, 620SB037, and 620SB056.

Lead Partitioning Coefficient in Wash Basin Area

As shown in Table 3-2, the K_d for the soil beneath the loading dock in the Wash Basin Area was calculated at values ranging from 103 to 19,000 L/kg. The K_d for soil in Area A was calculated between 242 and 847 L/kg, corresponding to the elevated lead levels detected in Area A. A geometric mean of the K_d values was calculated to provide a representative coefficient for Area A, 430 L/kg. Calculations are provided in Appendix B. This value is lower than partitioning coefficients typically reported in the literature [range = 700 to 23,000 L/kg for soil pH from 6.4 to 8.7 (Understanding Variation in Partition Coefficient, K_d, Values [EPA 402-R-99-004B, August 1999)]. Although low K_d values generally indicate a greater potential for migration to groundwater, it should be noted that no lead has been

3.3.4 SSL for Lead at AOC 620

SSLs were calculated using the following equation:

$$SSL = K_d \times MCL \times DAF$$

Where MCL = Maximum Contaminant Level. The National Primary Drinking Water Standard Action Level of 0.015 mg/L was used for lead although it is applicable to treated water at the tap. The SSLs calculated from the area-specific K_d values and the site-specific DAF are listed in Table 3-2.

Wash Basin Area SSL

The SSL for the future unpaved condition in Area A was calculated at 56 mg/kg, and for a future paved condition, the SSL was calculated at 240 mg/kg. Outside of Area A, the SSL for the future unpaved condition was calculated at 670 mg/kg, and 2900 mg/kg for the paved condition.

Acid Tank Room Area SSL

The K_d values derived in Appendix B and listed in Table 3-2 were in the general range of published values. A geometric mean K_d of 24,000 L/kg was identified for the soil in the Acid Tank Area, not including the apparent outlier at 620SB036. The SSL equation described above was used to derive an SSL of 3200 mg/kg for the future unpaved condition, and 14,000 mg/kg for the paved condition.

3.3.5 SSL for Mercury at AOC 620

Table 3-2 and Appendix B show that the partitioning coefficient for mercury measured from soil sample 620SB030, outside of the loading dock, was calculated at 4600 L/kg. This is an order of magnitude higher than the K_d measured in Area A, with a geometric mean of 340 L/kg. To be conservative, the Area A K_d was used for AOC 620 mercury SSL calculations. An MCL of 0.002 mg/L was assumed in the SSL equation. The DAF values used for the lead SSL calculations, with a conservative value of source length L of 80 ft, were used to calculate an SSL of 5.8 mg/kg for the unpaved future scenario, and 26 mg/kg for the paved scenario.

3.4 Application of MCS for Lead at AOC 620

The MCS for surface soil (0 to 1 ft) is the lower value of the RBC and the site-specific SSL, in areas exceeding background conditions where resulting site averages do not exceed MCS values. The MCS for subsurface soil (greater than 1 ft bls) is the SSL, once background levels are exceeded in an area. For AOC 620, the lead SSL-based MCS is identified differently for

the three areas of the site. Table 3-3 presents the proposed final cleanup concentrations for each area and soil depth.

TABLE 3-3
Final Lead Cleanup Concentrations
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Compex

Area	Health-Based MCS mg/kg	SSL-Based MCS mg/kg	Background Concentration Range mg/kg		Final Cleanup Concentration mg/kg	
			Surface Soil (0 – 1 ft)	Subsurface Soil (greater than 1 ft)	Surface Soil (0 – 1 ft)	Subsurface Soil (greater than 1 ft)
Wash Basin Area, Area A	1,220	56	3.5 - 275	2.4 - 123	275	123
Wash Basin Area, outside of Area A	1,220	670	3.5 - 275	2.4 - 123	670	670
Acid Tank Area	1,220	3,200	3.5 - 275	2.4 - 123	1,220	3,200

3.5 Application of MCS for Mercury at AOC 620

Table 3-4 presents all mercury data from AOC 620. As seen in Figure 2-4 and Table 3-3, all surface soil RFI samples at AOC 620 reveal mercury concentrations at least one order of magnitude less than the health-based MCS for unrestricted land use and two orders of magnitude less than the industrial land use MCS.

As noted in Table 3-4, there is no evidence of mercury concentrations greater than the site-specific SSL of 5.8 mg/kg for unpaved site conditions. It should be noted that mercury has not been detected in groundwater at AOC 620. Therefore, remediation of mercury-containing soils is not warranted for protection of human health or of groundwater, and will not be addressed further in the IM.

TABLE 3-1
Background Concentration Range (Zones F and G)
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Complex

	Lead, mg/kg	Mercury, mg/kg
Surface Soil	3.5 – 275	0.06 – 2.0
Subsurface Soil	2.4 – 123	0.04 – 0.57

TABLE 3-2
Partitioning Coefficients and SSLs
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Complex

Boring	Sample Location	Soil Sample Type	Lead					Mercury				
			Soil Concentration mg/kg	Kd, L/kg	MCL, µg/L	Unpaved SSL, mg/kg	Paved SSL, mg/kg	Soil Conc, mg/kg	Kd, L/kg	MCL, µg/L	Unpaved SSL, mg/kg	Paved SSL, mg/kg
F620SB030	Wash Basin Area, Outside of Loading Dock	Surface	476	NC				1.68	4,583			
F620SB055	Wash Basin Area, Outside of Loading Dock	Surface	3.05	103 [a]				NC	NC			
F620SB056	Wash Basin Area, Outside of Loading Dock	Surface	2.67	290 [b]				NC	NC			
		Subsurface	2.66	289 [b]				NC	NC			
F620SB053	Wash Basin Area, Beneath Loading Dock,	Surface	153	4,561				1.06	NC			
	North of Area A	Subsurface	97.8	3629				1.52	NC			
F620SB035	Wash Basin Area, Beneath Loading Dock,	Surface	770	19,039				NC	NC			
	South of Area A											
Geometric Mean, Wash Basin Area, Outside of Area A (excludes F620SB056 and surface F620SB055 - see footnote)				**5,100**	15	**670**	**2,900**		**4,600**	2	80	350
F620SB032	Wash Basin Area, Beneath Loading Dock	Surface	1,500	847				NC	NC			
	(Area A)											

TABLE 3-4
Mercury in Surface and Subsurface Soil
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Compex

	Surface Soil	Subsurface Soil
RBC, Unrestricted Land Use	23	NA
RBC, Industrial Land Use	610	NA
SSL, DAF = 8.7	5.8	5.8
Background Range	0.06 - 2.0	0.04 - 0.57
Units	mg/kg	mg/kg

Sample Location	Surface Concentration	Qualifier	Subsurface Concentration	Qualifier

RBC = EPA Region IX PRGs, November 2000

U = Analyte not detected; value is detection limit

UJ = Analyte not detected; value is estimated detection limit

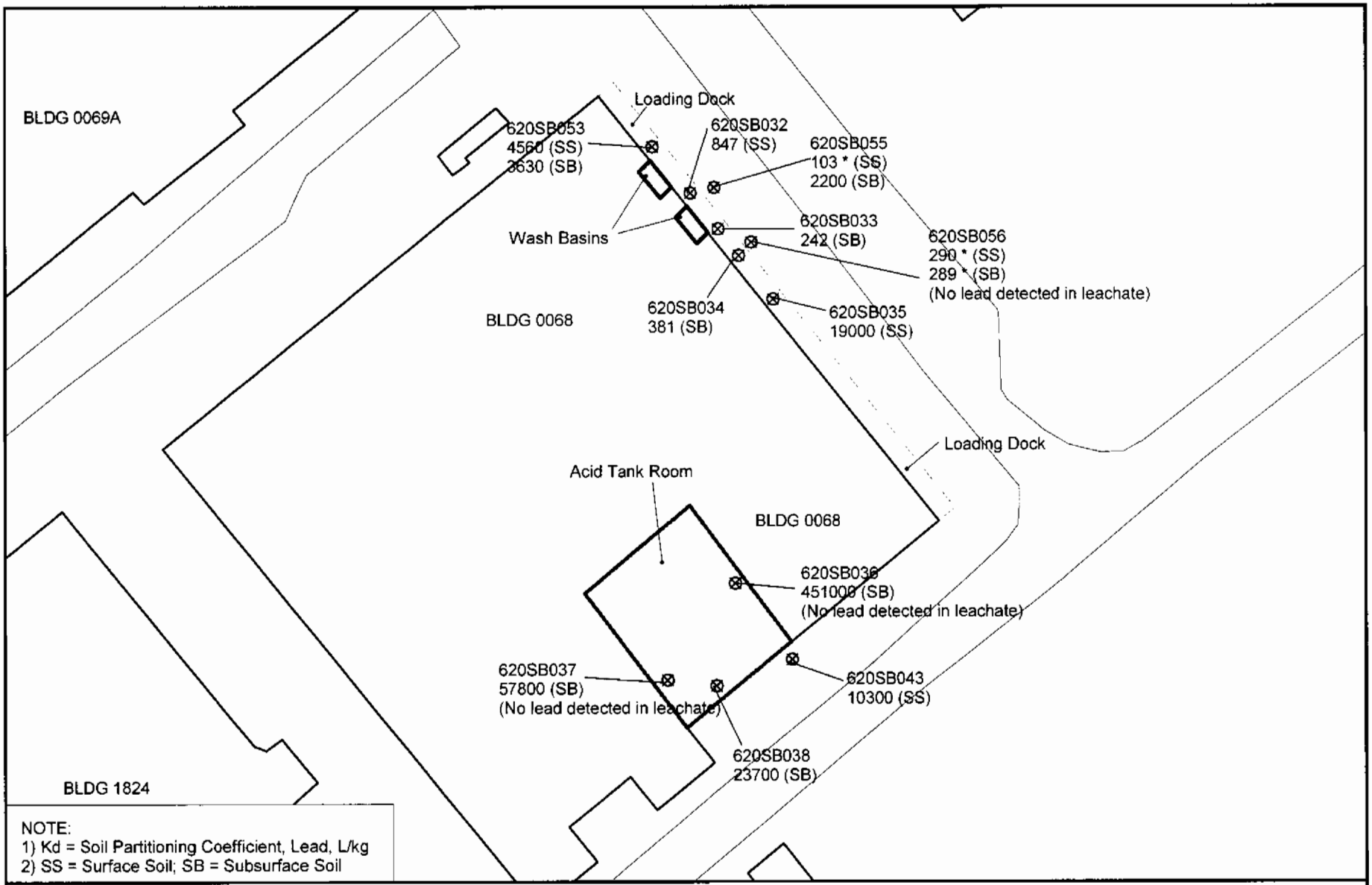


Figure 3-1
Lead Kd in IM Pre-Excavation Samples
AOC 620 IM Workplan - Phase II
Zone F
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_F\Aoc_620\Aprs\aoc620_imworkplan_phaseii.apr, Date: 18 Dec 2001 14:09, User: ASPOSATO, EGIS: Charleston Naval Complex - Figure 3-1 Lead Kd in IM Pre-Excavation Samples

Section 4.0

4.0 Technical Approach to IM Soil Removal

This section outlines the technical approach to the removal of lead-contaminated soil in two areas, the Acid Tank and the Wash Basin Area, where lead concentrations were detected above the MCS, either the industrial use RBC of 1,220 mg/kg, the area-specific SSL, or background concentrations, as appropriate. Other areas of AOC 620 contain lead at or near the background reference concentration, and less than the unrestricted land use screening concentration of 400 mg/kg.

As discussed in Section 3.0 of this IM Work Plan, the soils containing mercury at AOC 620 do not warrant remediation.

4.1 Contaminant Delineation

The lead concentrations in Phase I IM surface soil samples shown in Table 4-1 were screened against a CNC-specific MCS of 1,220 mg/kg for industrial land use, an area-specific SSL, and the surface soil background range of concentrations for combined Zones F and G. The lead concentrations in Phase I IM subsurface soil samples shown in Table 4-2 were screened against the area-specific SSL and the subsurface soil background range of concentrations for combined Zones F and G.

The extent of contamination in the Wash Basin and Acid Tank Areas has been evaluated to estimate the area for soil removal for the Phase II IM. The data from the RFI and the Phase I IM are discussed below. A comprehensive list of lead concentrations in surface soil at AOC 620 is presented in Table 4-1, and a similar list for subsurface soil at AOC 620 is presented in Table 4-2. Figures 2-3 and 2-5 show lead concentrations for the two main areas of the site.

4.1.1 Wash Basin Area

Wash Basin Area - Outside of Area A

The area outside of Area A, including beneath the building, appears to be minimally impacted. Including samples collected previously for the AOC 609 RFI, surface soil lead concentrations were reported ranging from 3 to 770 mg/kg, and subsurface soil concentrations were reported ranging from 3 to 303 mg/kg. The area mean lead concentration in the one-half acre exposure area must be less than the health-based MCS to be protective of human health. The entire Wash Basin Area may be considered one-half acre, extending as far south as sample 620SB003, located 90-ft southeast from the wash basins.

The average lead concentration in surface soil within the exposure area at the Wash Basins, and not including the samples located inside Area A, is 129 mg/kg. Therefore, the residual concentrations after removal of Area A soils are much lower than the unrestricted land use – based MCS of 400 mg/kg and the industrial land use-based MCS of 1220 mg/kg. Therefore, the soil outside of Area A does not warrant remedial action with respect to protection of human health, and remaining soils in the area are suitable for unrestricted land use.

The SSL-based MCS for this area is 670 mg/kg. Using the highest concentration of surface or subsurface lead from each boring, the average lead concentration throughout the area outside of the building and outside of Area A is 226 mg/kg, compared to the SSL of 670 mg/kg. Therefore, the soil outside of Area A does not require remedial action with regard to protection of groundwater, because residual concentrations do not indicate a leachability concern for this area.

Using the highest concentration of surface or subsurface lead from each boring collected from soil beneath the building, the average lead concentration is 29 mg/kg, less than the more conservative SSL-based MCS for Area A, as well as lower than the health-based MCS for unrestricted land use. Therefore, lead in soil beneath the building is not likely to adversely effect the groundwater or present a health concern in the future, and does not require remedial action.

Therefore, the area outside of Area A does not require remediation to meet industrial use standards, and meets standards for unrestricted land use.

Wash Basin Area - Area A

Area A is located near the wash basins underneath the loading dock (see Figure 2-3). Lead concentrations detected in RFI and Phase I IM samples indicate a release from the wash basin drain line beneath the loading dock. The highest lead concentration was detected opposite the southernmost wash basin, with lead concentrations in excess of the MCS extending between sample location 620SB017 and sample location 620SB035. Area A has been defined as the area beneath the loading dock between these two sample locations. Area A is bounded on the west by the building grade wall and on the east by the edge of the loading dock.

The pre-excavation samples located outside of the loading dock indicated lead concentrations below the MCS, and except for one location (620SB030, 476 mg/kg), below the unrestricted land use RBC. The excavation area will include Area A beneath the loading

dock and extend 3 feet to the east in the area of 620SB030 to include the soil at 620SB030. Figure 4-1 shows the lateral extent of the IM soil excavation area in the Wash Basin Area.

4.1.2 Acid Tank Area

Acid Tank Area - Inside Building 68

As seen in Tables 4-1 and 4-2, the Phase I IM samples have indicated that the soil beneath the Acid Tank room has lead concentrations greater than the health-based MCS of 1,220 mg/kg in surface soil, and the SSL-based MCS of 3,200 mg/kg in subsurface soil. The lateral extent of the area with elevated lead concentrations has not been identified to the north or east beneath the building. Pre-excavation sampling will be continued until the soil with lead concentrations greater than the MCS has been delineated, as provided in the Phase I IM Work Plan. The Phase III IM Work Plan will describe the extent of contamination beneath Building 68 in the Acid Tank Area.

Acid Tank Area - Outside of Building 68

The soil outside of Building 68 south and east of the Acid Tank Room has lead concentrations ranging from 3 mg/kg to 736 mg/kg, with one exception at 620SB004 (4,250 mg/kg), where monitoring well 620GW004 was installed. The soil at 620SB004 has been re-sampled (620SB041), resulting in a lead concentration of 736 mg/kg. The average of these two values (2,500 mg/kg) is used to evaluate area-wide lead concentrations outside of the building in the Acid Tank Area.

The average lead concentration was calculated for surface soil south and east of Building 68, including RFI sample locations identified for AOC 620. This area is approximately 250 x 110 ft, or 2/3 of an acre. The average surface soil lead concentration is 315 mg/kg, which is less than the unrestricted land use MCS, both health-based (400 mg/kg) and SSL-based (3,200 mg/kg). Therefore, surface soil outside of Building 68 in the Acid Tank Area does not require remediation. Likewise, subsurface soil outside of Building 68 in the Acid Tank Area has an average lead concentration of 142 mg/kg, and does not require remediation.

4.2 Soil Excavation in Area A

The loading dock will be removed and the soil in Area A will be excavated to a 4-ft depth below grade, or to groundwater if the groundwater level is shallower than 4 ft. Soil excavation will not be conducted beneath below-grade walls or pile caps.

Dust control and runoff control measures will be implemented during concrete removal to reduce the potential for lead-contaminated soils to become airborne. During excavation, the

IM areas will be monitored for dust levels using appropriate real-time measuring instruments. If dust levels are higher than the action levels set forth in the CNC Health and Safety Plan, adequate dust suppression measures will be taken. All sampling, excavation, and stockpiling activities will be performed according to the approved CNC Health and Safety Plan. The excavations will be backfilled with clean soil after removal of lead-contaminated soil.

4.3 Waste Management and Disposal

Four waste streams will be generated as part of this IM:

- Concrete debris from Building 68 floors and loading dock
- excavated soils
- decontamination wastes
- personal protective equipment (PPE) and stockpile liners

Uncontaminated concrete debris will be disposed of in a construction debris landfill. Excavated soils will be characterized in accordance with South Carolina Hazardous Waste Management Regulations (Section SCDHEC R.61-79.261) and disposed of in accordance with all applicable regulations and permits. Soils excavated from outside of the building will be transferred immediately to disposal containers (e.g., lined roll-off box or similar container).

Table 4-3 presents the results of TCLP tests on composite soil samples from both the Wash Basin Area and the Acid Tank Room Area. Soils that test hazardous by TCLP (greater than 5 mg/L lead) will be delivered to a permitted Treatment, Storage, and Disposal Facility (TSDF) and soils with TCLP less than 5 mg/L lead will be disposed of as non-hazardous material. Existing data indicate that the soil within the southern half of Area A is not hazardous. Additional soil samples may be collected within Area A to better delineate the hazardous from the non-hazardous soils.

Decontamination wastes and PPE will be disposed in accordance with appropriate regulations. Offsite transportation and disposal will be performed by properly permitted and licensed subcontractors. Materials designated for offsite disposal will be documented, tracked, and their disposition verified. This information will be documented in the IM Completion Report generated for AOC 620.

TABLE 4-1
Summary of Lead in Surface Soil
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Compex

Location	Sample Date	Concentration mg/kg		RBC mg/kg	SSL mg/kg	Background Range mg/kg
F036SB001	10/09/1996	**1,600**	=	1220	3200	3.5 - 275
F036SB002	10/08/1996	69.6	=	1220	3200	3.5 - 275
F036SB003	10/09/1996	70.3	=	1220	3200	3.5 - 275
F619SB011	09/10/1996	58.7	=	1220	3200	3.5 - 275
F620SB001	09/16/1996	42	=	1220	3200	3.5 - 275
F620SB002	08/27/1996	48	=	1220	670	3.5 - 275
F620SB003	09/16/1996	166	=	1220	670	3.5 - 275
F620SB004	09/10/1996	**4,250**	=	1220	3200	3.5 - 275
F620SB005	09/16/1996	79	=	1220	3200	3.5 - 275
F620SB006	10/04/1996	10	J	1220	3200	3.5 - 275
F620SB007	01/09/1997	287	=	1220	3200	3.5 - 275
F620SB008	01/09/1997	89	=	1220	3200	3.5 - 275
F620SB008	10/15/1999	89	=	1220	3200	3.5 - 275
F620SB009	01/10/1997	62	=	1220	3200	3.5 - 275
F620SB010	11/17/1999	98	J	1220	3200	3.5 - 275
F620SB011	11/16/1999	27	J	1220	3200	3.5 - 275
F620SB012	11/16/1999	61	J	1220	3200	3.5 - 275
F620SB013	11/16/1999	78	J	1220	3200	3.5 - 275
F620SB014	11/16/1999	44	J	1220	3200	3.5 - 275
F620SB017	06/06/2001	172	=	1220	670	3.5 - 275
F620SB018	06/06/2001	**18,400**	=	1220	56	3.5 - 275
F620SB022	10/10/2001	25.4	=	1220	670	3.5 - 275
F620SB023	10/10/2001	5.91	=	1220	670	3.5 - 275
F620SB024	10/10/2001	4.03	=	1220	670	3.5 - 275
F620SB025	10/10/2001	5.82	=	1220	670	3.5 - 275
F620SB026	10/10/2001	4.92	=	1220	670	3.5 - 275
F620SB027	10/10/2001	5.17	=	1220	670	3.5 - 275
F620SB028	10/10/2001	4.67	=	1220	670	3.5 - 275
F620SB029	10/10/2001	71.6	=	1220	670	3.5 - 275
F620SB030	10/10/2001	**476**	=	1220	56	3.5 - 275
F620SB031	10/10/2001	273	=	1220	670	3.5 - 275
F620SB032	10/10/2001	**1,500**	=	1220	56	3.5 - 275
F620SB033	10/10/2001	**430**	=	1220	56	3.5 - 275
F620SB034	10/10/2001	106	=	1220	56	3.5 - 275
F620SB035	10/10/2001	**770**	=	1220	670	3.5 - 275
F620SB036	10/10/2001	570	=	1220	3200	3.5 - 275
F620SB037	10/10/2001	**2,350**	=	1220	3200	3.5 - 275
F620SB038	10/10/2001	952	=	1220	3200	3.5 - 275
F620SB039	10/10/2001	145	=	1220	3200	3.5 - 275

TABLE 4-1
Summary of Lead in Surface Soil
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Compex

Location	Sample Date	Concentration mg/kg		RBC mg/kg	SSL mg/kg	Background Range mg/kg
F620SB040	10/10/2001	93.5	=	1220	3200	3.5 - 275
F620SB041	10/10/2001	736	=	1220	3200	3.5 - 275
F620SB042	10/10/2001	2.81	=	1220	3200	3.5 - 275
F620SB043	10/10/2001	632	=	1220	3200	3.5 - 275
F620SB044	10/10/2001	224	=	1220	3200	3.5 - 275
F620SB045	10/10/2001	239	=	1220	3200	3.5 - 275
F620SB046	10/10/2001	195	=	1220	3200	3.5 - 275
F620SB053	11/26/2001	153	=	1220	670	3.5 - 275
F620SB054	11/26/2001	**1,820**	=	1220	56	3.5 - 275
F620SB055	11/26/2001	3.05	=	1220	670	3.5 - 275
F620SB056	11/26/2001	2.67	=	1220	670	3.5 - 275
F620SB057	11/26/2001	**790**	=	1220	56	3.5 - 275
F620SB060	11/26/2001	406	=	1220	3200	3.5 - 275

Background Range is concentrations of combined Zone F and G grid samples
SSL based on site-specific Kd values and site-specific DAF = 8.7 for unpaved condition
Values in bold type exceed MCS and background range
= Actual measured concentration
RBC Risk-Based Concentration, based on industrial exposure, ALM

TABLE 4-2
Summary of Lead in Subsurface Soil
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Compex

Location	Sample Date	Concentration mg/kg		SSL mg/kg	Background Range mg/kg
F036SB001	10/09/1996	127	=	3200	2.4 - 123
F620SB005	09/16/1996	58.3	=	3200	2.4 - 123
F620SB006	10/04/1996	34	J	3200	2.4 - 123
F620SB007	01/09/1997	57.3	=	3200	2.4 - 123
F620SB008	01/09/1997	51.6	=	3200	2.4 - 123
F620SB008	10/15/1999	105	J	3200	2.4 - 123
F620SB009	01/10/1997	5.3	=	3200	2.4 - 123
F620SB010	11/17/1999	4.9	J	3200	2.4 - 123
F620SB011	11/16/1999	18.2	J	3200	2.4 - 123
F620SB012	11/16/1999	82.8	J	3200	2.4 - 123
F620SB013	11/16/1999	88.3	J	3200	2.4 - 123
F620SB014	11/16/1999	27.9	J	3200	2.4 - 123
F620SB017	06/06/2001	**236**	=	56	2.4 - 123
F620SB018	06/06/2001	**1,350**	=	56	2.4 - 123
F620SB022	10/10/2001	157	=	670	2.4 - 123
F620SB023	10/10/2001	13.3	=	670	2.4 - 123
F620SB024	10/10/2001	3.1	=	670	2.4 - 123
F620SB026	10/10/2001	5.56	=	670	2.4 - 123
F620SB027	10/10/2001	7.9	=	670	2.4 - 123
F620SB028	10/10/2001	6.21	=	670	2.4 - 123
F620SB032	10/10/2001	**1,120**	=	56	2.4 - 123
F620SB033	10/10/2001	**416**	=	56	2.4 - 123
F620SB034	10/10/2001	**1,100**	=	56	2.4 - 123
F620SB035	10/10/2001	303	=	670	2.4 - 123
F620SB036	10/10/2001	**3,880**	=	3200	2.4 - 123
F620SB037	10/10/2001	497	=	3200	2.4 - 123
F620SB038	10/10/2001	**3,270**	=	3200	2.4 - 123
F620SB039	10/10/2001	242	=	3200	2.4 - 123
F620SB040	10/10/2001	57.5	=	3200	2.4 - 123
F620SB041	10/10/2001	94.8	=	3200	2.4 - 123
F620SB042	10/10/2001	295	=	3200	2.4 - 123
F620SB043	10/10/2001	736	=	3200	2.4 - 123
F620SB044	10/10/2001	376	=	3200	2.4 - 123
F620SB045	10/10/2001	159	=	3200	2.4 - 123
F620SB046	10/10/2001	137	=	3200	2.4 - 123
F620SB053	11/26/2001	97.8	=	670	2.4 - 123
F620SB054	11/26/2001	**961**	=	56	2.4 - 123

TABLE 4-2
Summary of Lead in Subsurface Soil
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Compex

Location	Sample Date	Concentration mg/kg		SSL mg/kg	Background Range mg/kg
F620SB055	11/26/2001	63.1	=	670	2.4 - 123
F620SB056	11/26/2001	2.66	=	670	2.4 - 123
F620SB057	11/26/2001	**317**	=	56	2.4 - 123
F620SB060	11/26/2001	40.7	=	3200	2.4 - 123

Background Range is concentrations of combined Zone F and G grid samples

SSL based on site-specific Kd values and site-specific DAF = 8.7 for unpaved condition

Values in bold type exceed MCS and background range

= Actual measured concentration

TABLE 4-3
TCLP Results
Phase II IM Work Plan, AOC 620/SWMU 36, Zone F, Charleston Naval Compex

Sample Location	Soil Sample Type	Lead Concentration mg/kg		TCLP Leachate mg/L		TCLP Limit mg/L	Boring Location
F620SB054	Surface	1820	=	31.2	=	5	Wash Basin Area,
(composite)	Subsurface	961	=	0.743	=		Beneath Loading Dock
F620SB057	Surface	790	=	0.273	=		(Area A)
(composite)	Subsurface	317	=	0.084	J		
F620SB058	Subsurface	3575 *	=	1.98	=	5	Acid Tank Area,
(composite)							Beneath Acid Tank Room
F620SB059	Surface	2350 **	=	0.0172	U		

Values in bold type exceed MCS or TCLP limit

* composite of F620SB036 and F620SB038; average lead concentration

** lead concentration from 620SB037

= Actual measured concentration

J Estimated concentration

TCLP Toxicity Characteristic Leaching Procedure

U Analyte not detected; value is the detection limit

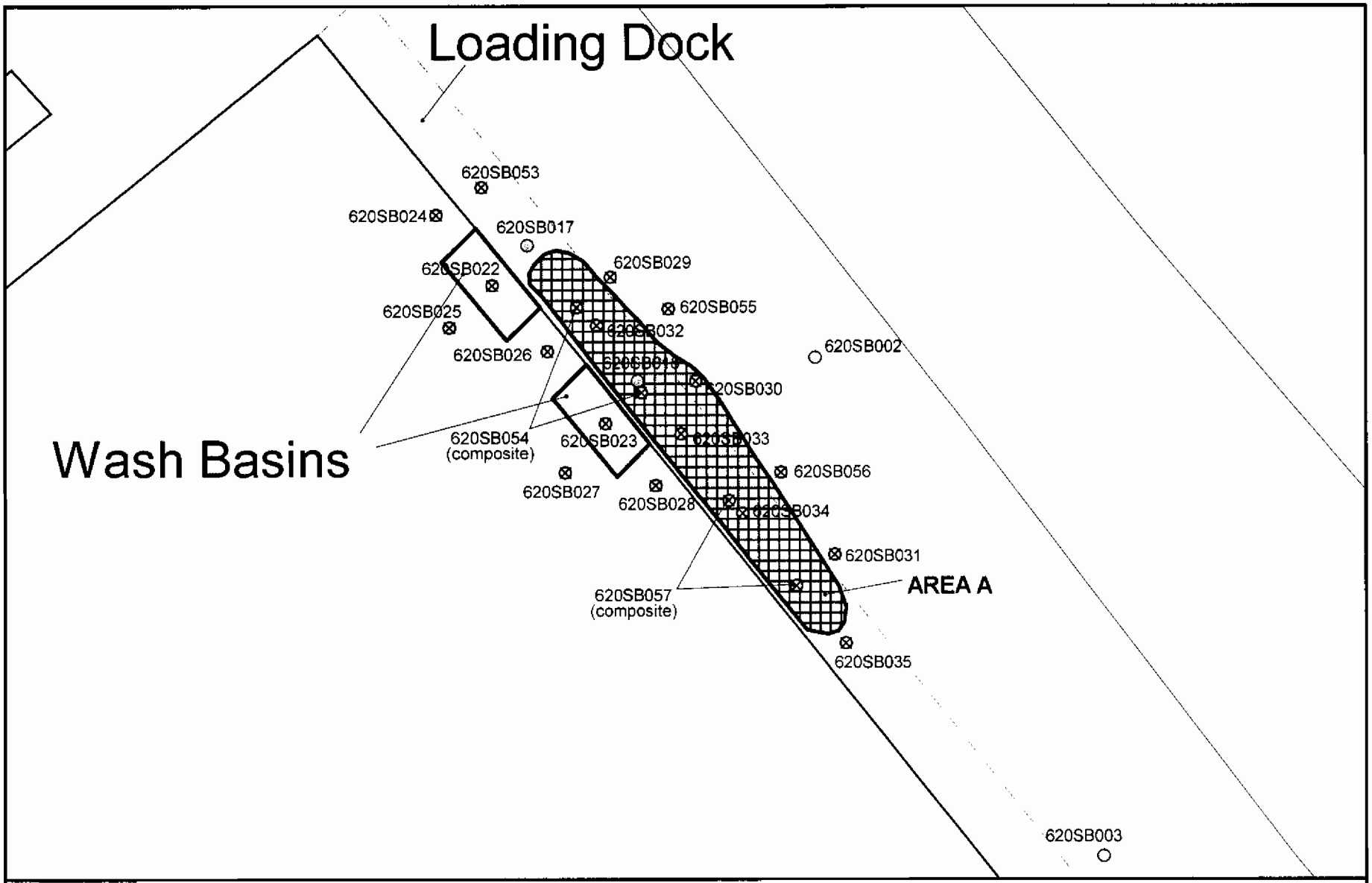


Figure 4-1
Soil Excavation Area in Wash Basin Area
AOC 620 IM Work Plan - Phase II
Zone F
Charleston Naval Complex

CH2MHILL

File Path: C:\18gis\Projects\Zone_F\Aoc_620\Aprs\aoc620_imworkplan_phaseii.apr, Date: 11 Dec 2001 12:48, User: ASPOSATO, EGIS: Charleston Naval Complex - Figure 4-1 Soil Excavation Area in Wash Basin Area

Section 5.0

5.0 Phases II and III Interim Measure Completion Report

A soil IM Completion Report will be submitted within 60 days of receipt of the final data for the Phase III soil excavation IM. The Completion report will summarize the actions that were taken and provide the following information:

- Analytical data reports from the pre-excavation sampling
- Excavated area measurements and volumes of excavated soil
- Nature and volume of excavated wastes generated
- Waste transportation and disposal records
- Site photographs
- Problems encountered during the excavation IM, if any, and the corrective measures implemented

Section 6.0

6.0 References

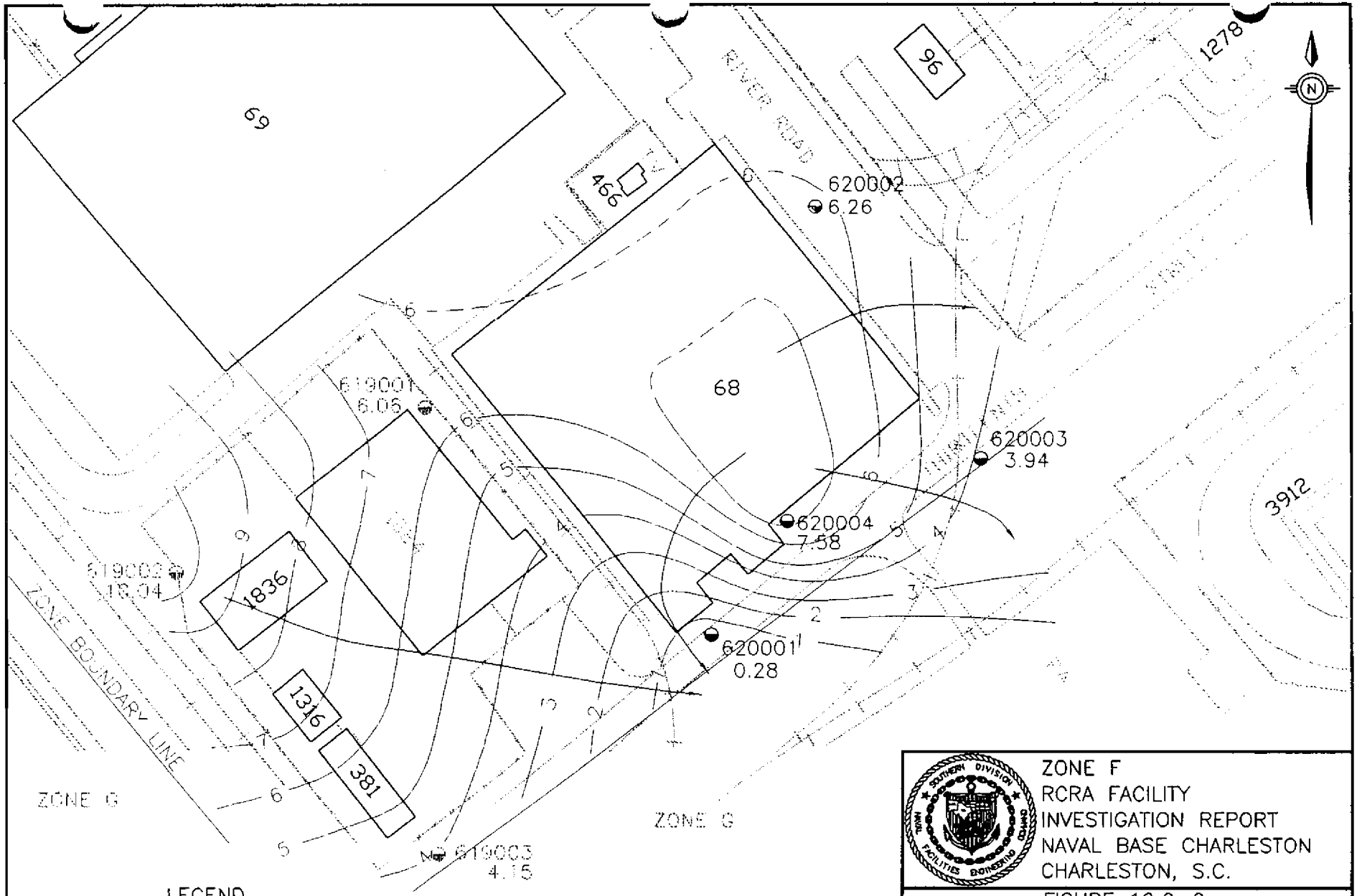
CH2M-Jones. *Technical Memorandum: Application of Soil-Screening Levels (SSLs) at Charleston Naval Complex*. March 9, 2001.

CH2M-Jones. *Phase I Interim Measure Work Plan, AOC 620/SWMU 36, Zone F*. Revision 0. September 2001.

CH2M-Jones. *Technical Memorandum: Adult Lead Methodology (ALM) Derived Target Lead Concentrations for Industrial Land Use*. November 9, 2001.

EnSafe Inc. *Zone F RFI Report*. Revision 0. NAVBASE Charleston. 1997.

Appendix A



ZONE F
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.2–2
SHALLOW GROUNDWATER
LOW–TIDE POTENTIOMETRIC MAP
SWMU #36 BLDG 68, BATTERY SHOP
AND AOC #620 BATTERY SHOP, BLDG 68

DWG DATE: 10/30/97 | DWG NAME: 2906BSLT


Hydraulic Conductivity
From USGS ModFlow
BLDG 68
AOC 620
4.0 ft/day
5.0 ft/day
6.0 ft/day
3.5 ft/day
4.0 ft/day
2.0 ft/day
1.0 ft/day

Infiltration Rate Derivation

Infiltration can be defined as:

$$I = (P-ET)(1-C_r)$$

Where:

I = Infiltration (in/yr)

P = Precipitation (in/yr)

ET = Evapotranspiration (in/yr)

C_r = runoff coefficient

For Charleston, SC, a value of 46 in/yr is used for P (Park, 1985) and a value of 39.25 in/yr is used for ET (Laboratory of Climatology). For unpaved areas, a value of 0.20 is used for C_r (Florida DOT). For poorly paved (moderately degraded asphaltic concrete) surfaces, a value of 0.85 is used for C_r.

Using these values in the above equation results in a calculated infiltration of:

5.1 in/yr, or 0.14 m/yr for unpaved surfaces, and

1.0 in/yr, or 0.026 m/yr for paved surfaces.

References

Park, A.D., 1985, "The Groundwater Resources of Charleston, Berkeley, and Dorchester Counties, South Carolina: South Carolina Water Resources Commission Report 139", 146 p.

Laboratory of Climatology, Map.

State of Florida Department of Transportation, Drainage Manual, Volume 2, 1987.

Appendix B

Mercury

		620SB03001	620SB03401	620SB03403
Initial Soil Concentration	mg/kg	1.68	0.361	0.576
SPLP Water Concentration	mg/L	0.000365	0.000365	0.00422
Soil mass	kg	0.1	0.1	0.1
Water volume	L	2	2	2
Total contaminant mass in soil	mg	0.168	0.0361	0.0576
Total contaminant mass in water	mg	0.00073	0.00073	0.00844
Adjusted soil concentration	mg/kg	1.6727	0.3537	0.4916
Partition Coefficient Kd	L/kg	**4583**	**969**	**116**

SPLP non-detect for 620SB03001 and 620SB03401 - leachate concentration assumed at 1/2 detection limit.

MCL, mg/L	0.002

SSL = Kd x MCL x DAF

DAF, unpaved	8.7
DAF, paved	38.2

geometric mean of Kd beneath loading dock		rounded off
(620SB03401 and 620SB03403)	336	340
SSL, unpaved	5.8	5.8
SSL, paved	26	26

Kd outside of loading dock		rounded off
(620SB03001)	4583	4600
SSL, unpaved	80	80
SSL, paved	350	350

Lead

Sample Number		620SB05301	620SB05302	620SB03201	620SB03303	620SB03403	620SB03501	620SB05501	620SB05502	620SB05601	620SB05602	620SB03603	620SB03703	620SB03803	620SB04301
Initial Soil Concentration	mg/kg	153	97.8	1500	416	1100	770	3.05	63.1	2.67	2.66	3880	497	3270	632
SPLP Water Concentration	mg/L	0.0334	0.0268	1.73	1.59	2.74	0.0404	0.0248	0.0284	0.0086	0.0086	0.0086	0.0086	0.138	0.0611
Soil mass	kg	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Water volume	L	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total contaminant mass in soil	mg	15.3	9.78	150	41.6	110	77	0.305	6.31	0.267	0.266	388	49.7	327	63.2
Total contaminant mass in water	mg	0.0668	0.0536	3.46	3.18	5.48	0.0808	0.0496	0.0568	0.0172	0.0172	0.0172	0.0172	0.276	0.1222
Adjusted soil concentration	mg/kg	152.332	97.264	1465.4	384.2	1045.2	769.192	2.554	62.532	2.498	2.488	3879.828	496.828	3267.24	630.778
Partition Coefficient Kd	L/kg	**4561**	**3629**	**847**	**242**	**381**	**19039**	**103**	**2202**	**290**	**289**	**451143**	**57771**	**23676**	**10324**

Area A

Surface soil	X		X			X	X		X					X
Subsurface soil		X		X	X			X		X	X	X	X	
wash basin area - beneath loading dock	X	X	X	X	X	X								
wash basin area - outside of loading dock							X	X	X	X				
inside acid tank room											X	X	X	
outside acid tank room - outdoors														X

shaded indicates lead not detected in leachate; value is one-half detection limit

For DAF = 1, SSL = Kd x MCL

		Individual SSL, mg/kg													
DAF, unpaved	8.7	595	474	111	32	50	2485	13	287	38	38	58874	7539	3090	1347
DAF, paved	38.2	2613	2080	485	138	219	10910	59	1262	166	166	258505	33103	13566	5915
No dilution/attenuation	1	68	54	13	4	6	286	2	33	4	4	6767	867	355	155

MCL, mg/L 0.015

SSL = Kd x MCL x DAF

		rounded off	
geometric mean of Kd beneath loading dock, Area A	427	430	
SSL, unpaved	56	56	
SSL, paved	245	240	
		rounded off	
geometric mean of Kd Wash Basin Area, outside of Area A	5132	5100	Disregard Kd as not meaningful where leachate non-detect and soil lead extremely low
SSL, unpaved	670	670	(No 620SB05601 or 620SB05602)
SSL, paved	2941	2900	Disregard 620SB05501 as not representative
		rounded off	
geometric mean of Kd in acid tank area	24170	24000	Disregard 620SB03603 as not representative
SSL using geometric mean and unpaved DAF	3154	3200	
SSL using geometric mean and paved DAF	13850	14000	